Space Weather Technical Forecast

Issued on Sunday 9 March 2025 at 00:55 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of Isolated M-class flares. G1 Minor Storm intervals expected day 1 (09 Mar). Chance of Active from day 3 (11 Mar).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Low with peak flare C3.9 at 08/1825 UTC from just over the east limb. There are six sunspot regions on the disc, however the majority of these are small and simple. The main exception is AR3012 in the southwest, which is longitudinally wide region, but has been generally inactive. This region is showing both decay within its trailer spots and some ongoing development within its leader spots.

No Earth-directed CMEs have been observed. The two eruptions on the southwest and northwest have been assessed as missing Earth.

Solar Wind / Geomagnetic Activity: An erratic connection to CH21/- was likely observed, although the potential for this to include a transient is not ruled out. Solar winds, measured by ACE at L1, rose from background, below 400 km/s, to be slightly elevated at around 500km/s. However this included a period 08/1600-2100 UTC which saw solar winds become elevated at 520-600 km/s. Density was above average at first, but eased to be around average, and below during this 08/1600-2100 UTC. Total Interplanetary Magnetic Field, Bt, erratically rose from being Weak at 8nT to be Moderate to Strong, ranging 10-19nT, peaking around 08/1610 UTC. The north-south component, Bz, was weak and variable at first, but became predominately Moderate negative (southward) from 08/1520 UTC, with minimum value -14nT. Phi angle was mainly negative (towards the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 2-3) until 08/1800 UTC, then saw two periods of G1 Minor Storm 08/1800-09/0000 UTC.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) at GOES18 was at Background. High energy electron flux (greater than 2 MeV) was mainly at Background with a brief period of Moderate at diurnal peak, reaching 491 pfu at 08/1645 UTC. The 24-hour fluence was below the Active threshold (1e8 integrated pfu), with 4.82e6 integrated pfu at 09/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is forecast, with a chance of Isolated M-class flares.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs. Ongoing erratic connection to CH21/- at first is expected to ease from later day 1 (09 Mar) onward, with the next

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fast wind enhancement from CH22/- either late on day 4 (12 Mar) or just beyond this period. G1-G2 Minor to Moderate storm intervals at first are expected to become Quiet to Unsettled with isolated Active intervals later day 1 (09 Mar), then mainly Quiet to Unsettled day 2 onward (10 Mar). The onset of the next fast wind brings a slight chance of G1 Minor Storm intervals day 4 (12 Mar).

Energetic Particles / Solar Radiation: High energy proton flux is expected to persist at Background. High energy electron flux is expected to reach High from day 2 (10 Mar), but with some chance of dropout from the further coronal hole enhancement day 4 (12 Mar). The associated 24 hour fluence is currently below the Active threshold, but is expected to rise with a chance of reaching Active day 3 (11 Mar).

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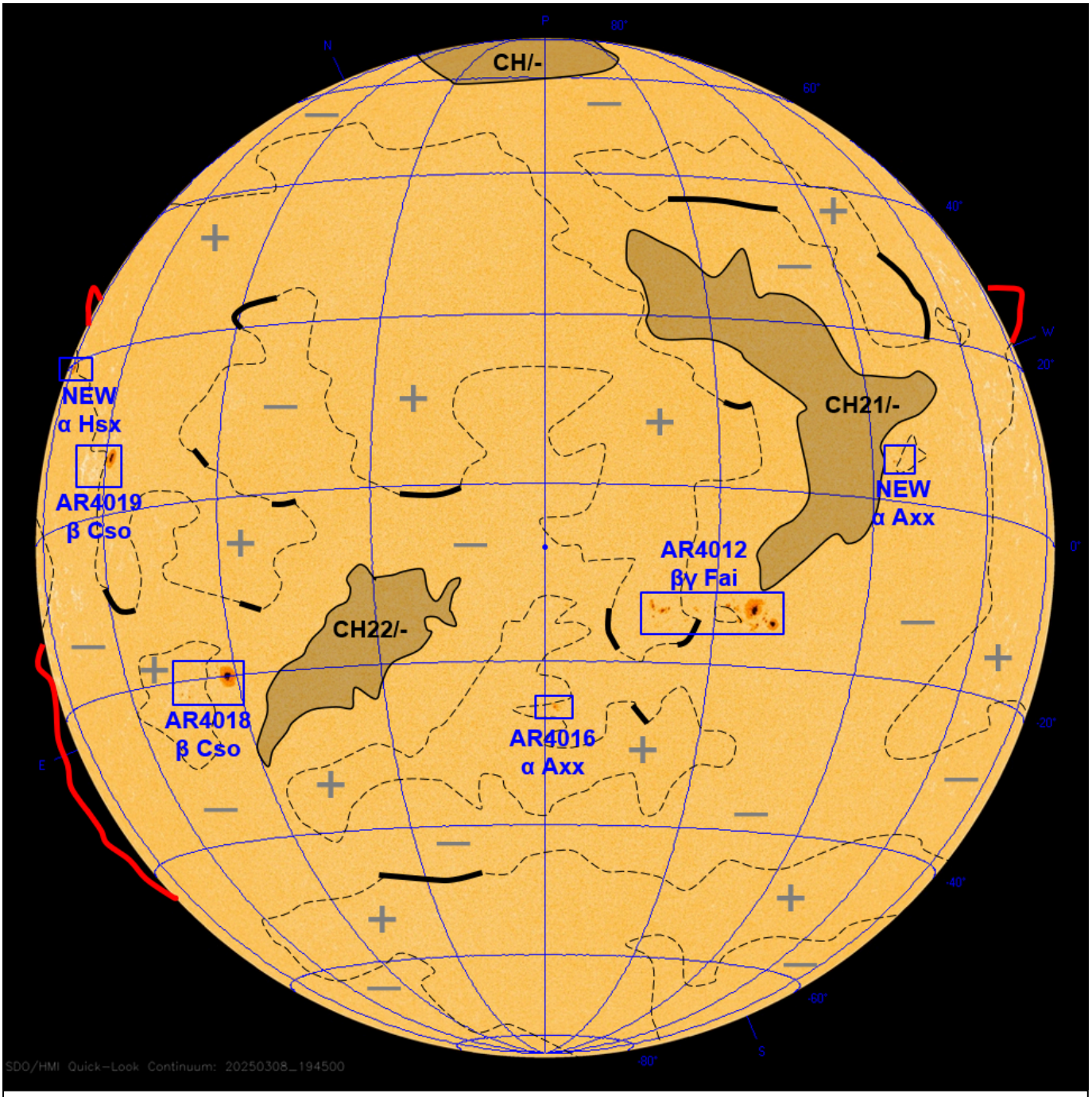
Figure 1: MOSWOC Solar Synoptic Map 08/2000 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

There are no Earth-directed CMEs, with the previous CMEs from 07 Mar now assessed as passing south and behind Earth.

Connection to CH21/- has been erratic to occur, likely due to its northern disc location compared to Earth which is 7.2 deg south of the solar equator. This erratic interaction is expected to continue early on day 1 (09 Mar), with peak solar winds potentially reaching 600 km/s for a time, before showing a gradual decline thereafter, as supported by MOSWOC Enlil. Due to the negative polarity of the feature, which is favoured for connection at this time of year, Active to G1 Minor storms are forecast at first, with a slight chance of G2 Moderate Storms. This activity will ease to become Quite to Unsettled with Active intervals day 2-3 (10-11 Mar).

The next coronal hole enhancement, from CH22/-, is expected to occur either late day 4 (12 Mar), but more likely on day 5 (13 Mar). This is in agreement with MOSWOC Enlil, with 27-day persistence not providing good guidance due to this feature being much reduced in terms of its western extent. However once this does connect, due to its near equator southern disc location and its negative polarity, Elevated to Strong solar winds along with a spell of G1-G2 Minor to Moderate storms are forecast.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	Yes	80	5	1	20
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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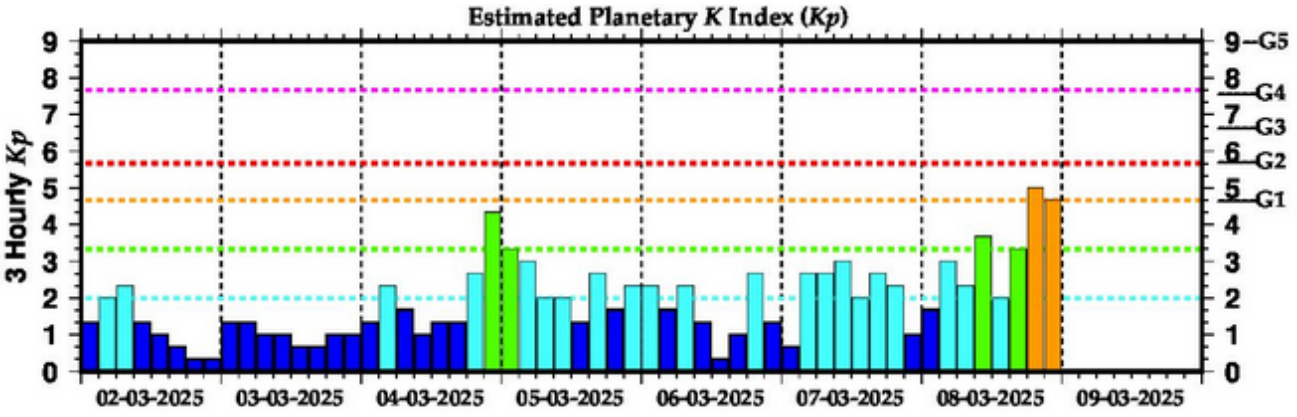
Figure 2: L1 (ACE) solar winds, showing erratic fast wind connection

Figure 3: BGS Estimated Kp values. Showing two G1 Periods 08/1800-2100 UTC and 08/2100-09/0000 UTC



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Radio Blackouts - X-Ray Flares

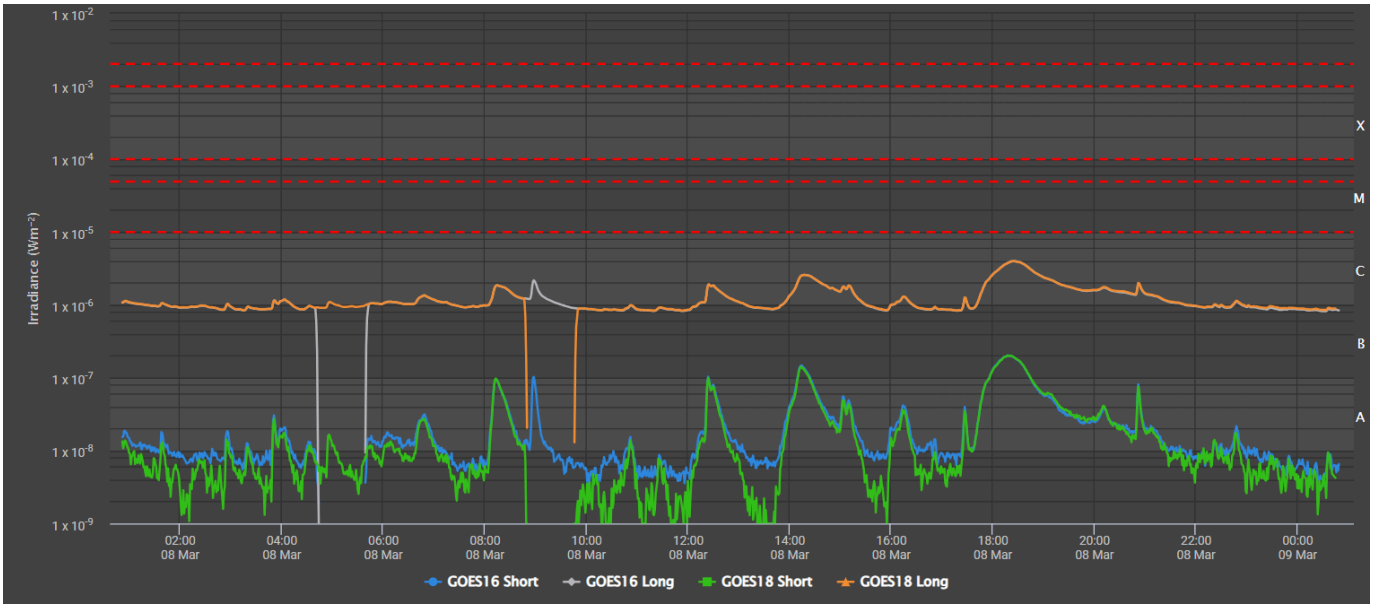
There are six sunspot regions currently on the Earth-facing disc, however these are all relatively small and simple, with only a slight chance of flaring. The main exception is AR4012 in the southwest, which is a larger and much wider group. Activity from this region has been very limited, with some recent sign of decay, especially within the region's trailer spots. However, there has been some ongoing slight development of the small spots around its leader, and the associated magnetic loops above the region have shown some brightening in e.g. SDO aia-211.

The other main source of activity is likely to be from a bright region of magnetic looping evident on the southeast limb. This was likely related to a C-flare and prominence eruption late on 08 Mar, and perhaps could indicate a new region to rotate onto the disc in the next 24-48 hours, although this is low confidence.

Due to these potential regions a chance of isolated M-class flares is maintained through the period, with activity expected to be Low to Moderate.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 (M Class)	No	40	40	50	50
Very Active	R3-R5 (X Class)	No	5	5	5	5

Figure 4: GOES 16/18 X-ray Irradiance



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Solar Radiation Storms (High Energy Protons)

GOES18 high energy (>10MeV) proton flux is expected to persist at Background, with the current regions on the disc unlikely to produce events that would give a notable enhancements.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	2	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

The high-energy electron flux (>2MeV) as observed at GOES16 is forecast to be at mainly background at first, but then rising as solar winds and geomagnetic activity eases from the recent fast wind connection. This will lead to Moderate flux, and an increasing chance of persistent High flux later day 2 (10 Mar). Confidence is low for the longevity of this high flux however due to the potential fast wind onset from CH22/- later on day 4 (12 Mar), providing the potential for drop out of the observed flux at GEO.

The associated fluence 24 hour is subsequently expected to rise through much of the period, with an increasing chance of reaching the Active threshold by day 3 (11 Mar). With the source of this enhancement being similar to the previous rotation, recurrence is likely providing the best guidance, albeit with the potential for this enhancement to occur sooner due to the likely reduction in solar winds on day 1-2 (09-10 Mar), which was not observed on the previous rotation. MOSWOC REFM has not yet taken account of the recent fast wind onset, and is currently providing poor guidance.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	5	20	50	50
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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Figure 5: GOES-16 Electron Flux (top) and associated fluence with REFM and 27-day Recurrence (bottom)

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